Russian-Thistle Distribution in Southern Idaho and Eastern Oregon in Relation to Beet Leafhopper Populations

By J. R. Douglass
and H. C. Hallock

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Russian-Thistle Distribution in Southern Idaho and Eastern Oregon in Relation to Beet Leafhopper Populations [1]

By J. R. DOUGLASS [2] and H. C. HALLOCK,[3] *entomologists, Entomology Research Division, Agricultural Research Service* [4]

The distribution of Russian-thistle (*Salsola kali* var. *tenuifolia* Tausch) in southern Idaho and eastern Oregon was studied in relation to the annual fall populations of beet leafhoppers (*Circulifer tenellus* (Baker)) during 1934–54. Hallock and Douglass (*3*) [5] showed that Russian-thistle is the most important summer host of this insect, and it has become widespread over a large area on the Snake River Plain, where the annual precipitation averages not over 12 inches.

Territory Studied

The territory studied is shown in figure 1. The place names given in this report apply to the various areas and not to towns or counties unless so specified. Combined areas are designated as sections.

There were four sections that extended westward along the Snake River from Fremont County in Idaho through a part of Malheur County in eastern Oregon. Eastern Idaho included the territory east of Minidoka County. South-central Idaho included Minidoka County and westward through Elmore County. Western Idaho covered the territory west of Elmore County and included part of Malheur County. Central Idaho covered Butte and Custer Counties.

The important areas studied were Golden Valley in Cassia County; Minidoka in Minidoka and eastern Lincoln Counties; Hollister in Twin Falls County; King Hill in western Twin Falls, western Gooding, and eastern Elmore Counties; and Mountain Home in Elmore and northern Owyhee Counties. In some years when Russian-thistle became extensive in other places, the study included the Nyssa and Wen-

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[2] Retired October 1957.

[3] Retired May 1955.

[4] The following persons participated in this study: J. C. Chamberlin, D. E. Fox, F. H. Harries, C. F. Henderson, W. E. Peay, F. H. Shirck, O. T. Deen, and V. E. Romney of the former Bureau of Entomology and Plant Quarantine; and R. L. Piemeisel of the former Bureau of Plant Industry, Soils, and Agricultural Engineering.

[5] Italic numbers in parentheses refer to Literature Cited, p. 20.

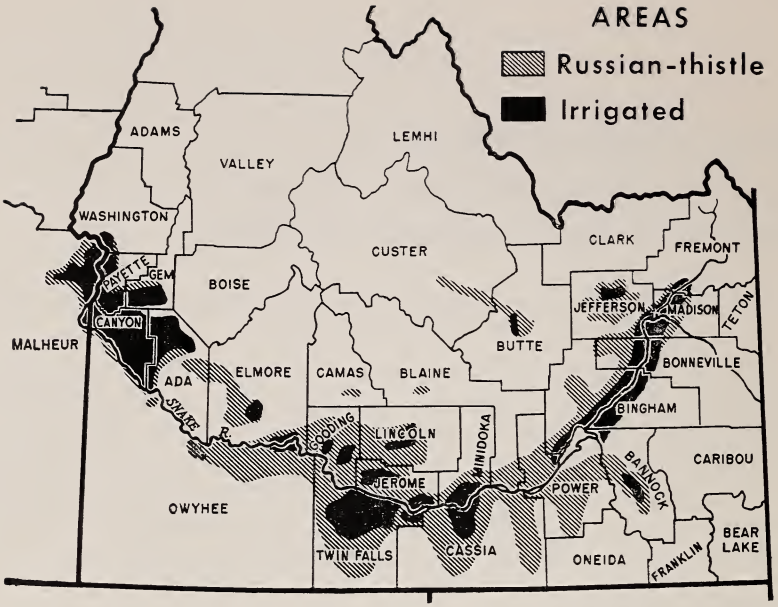

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FIGURE 1.—Map of southern Idaho and a part of Malheur County in Oregon.

dell areas. The Nyssa area comprised parts of Owyhee, Ada, Canyon, Gem, Payette, and Washington Counties in Idaho and part of Malheur County in Oregon, but the irrigated land there was excluded from the study. The Wendell area included parts of Lincoln, Jerome, and Gooding Counties in Idaho.

Between 1940 and 1945 the studies were discontinued in Madison, Jefferson, and Power Counties in eastern Idaho; in Idahome of eastern Cassia County in south-central Idaho; in Owyhee, Ada, Canyon, Gem, Payette, and Washington Counties in western Idaho; and in Butte and Custer Counties in central Idaho.

Perennial grasses and shrubs originally covered the Snake River Plain of southern Idaho, so that weeds did not become established to any extent. During World War I the demand for agricultural products increased, prices soared, and sagebrush (*Artemisia tridentata* Nutt.) lands (fig. 2) were cleared with an unparalleled surge and scope. Native vegetation was destroyed over large acreages in southern Idaho for both dry and irrigated farms. After the war low prices and successive crop failures, which were caused by a water shortage on the Salmon tract, the Oakley project, and the dry-farmed lands northwest of the Minidoka area, and elsewhere, resulted in the abandonment of large acreages of cultivated lands. This was gradual at first but became more rapid as conditions grew worse. Alien weeds became established on these idle lands (fig. 3), as well as mustards

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FIGURE 2.—Cleared sagebrush lands, with brush piled in windrows for burning.

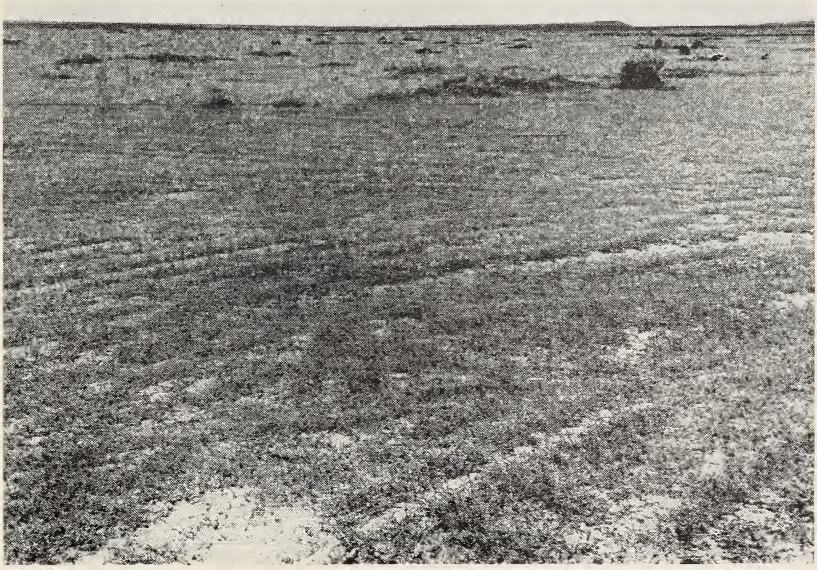

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FIGURE 3.—Good stand of pure pepperweed on abandoned farmland near Mountain Home, Idaho.

and Russian-thistle, so that conditions were very favorable for the production of the beet leafhopper.

The low precipitation, combined with excessive grazing by cattle and large herds of sheep, eliminated the native perennial grasses from large areas in the surrounding rangeland. Range fires also destroyed the native vegetation. When the original plant cover is destroyed, a succession of plants takes possession of the soil. First come the annual weeds, which have little forage value. They are followed by annual grasses. Then, if there is no further disturbance, native perennial grasses and shrubs return. On abandoned fields Russian-thistle is commonly the first to appear, followed by the mustards and downy chess (*Bromus tectorum* L.), a nonhost annual grass (fig. 4). On burned and overgrazed areas, mustards are generally first and then downy chess, but with further disturbance Russian-thistle appears. This succession may continue in an endless cycle, depending on the weather and other disturbing factors.

TC–561

FIGURE 4.—Dense stand of downy chess near St. Anthony, Idaho, October 26, 1937.

The amount of rangeland burned annually has been approximately 3,500 to 43,000 acres (table 1). During World War II the acreage of territory studied, which was reduced because of the small areas of Russian-thistle and insufficient personnel, and the large areas burned on the bombing ranges near Glenns Ferry and Mountain Home, Idaho, were not included in these figures. Because of these circumstances during the war, the large bare, or nearly bare, areas were invaded by leafhopper weed hosts, chiefly Russian-thistle.

TABLE 1.—*Annual acreages of burned rangeland and downy chess in southern Idaho, 1945–54*

Year	Burned rangeland	Downy chess
1945	6, 364	223, 488
1946	21, 330	162, 559
1947	16, 544	135, 205
1948	3, 475	163, 180
1949	11, 956	388, 671
1950	4, 179	447, 650
1951	11, 821	486, 646
1952	6, 739	304, 607
1953	42, 918	222, 745
1954	8, 974	349, 672

The territory studied included approximately 13,037,000 acres. About 1,300,000 acres were within the well-farmed, permanent irrigated districts and did not contain extensive areas of Russian-thistle. About 7,790,000 acres were uncleared rangeland that was rather weedy but did not contain any extensive cover of Russian-thistle. The remaining 3,947,000 acres contained practically all the Russian-thistle in southern Idaho. This plant did not cover an entire area, but it was scattered throughout it in rather extensive blocks, as shown in figure 1.

Methods

Each year during September and early October the acreage of Russian-thistle and the fall populations of beet leafhoppers were determined. The Russian-thistle acreage was estimated by the transect method, which consisted in driving through each area in an automobile along trails and section-line roads and recording the number of miles of Russian-thistle and other vegetation encountered on both sides of all roads transversed and the total number of miles traveled. The sum of the total miles of Russian-thistle recorded on both sides of the road was called the transect miles of thistle, and twice the total miles traveled within each area was called the transect miles. Then, since the total square miles included in each area were known, the square miles of thistle were estimated.

Since the density of the Russian-thistle in an area often ranged from 10 to 90 percent, the estimated areas of Russian-thistle could be compared with each other and from year to year only on the basis of the equivalent of 100-percent stand. The density in each patch sampled was estimated by taking 250 double paces at random through the thistle. The percentage of plant stand was determined by comparing the number of times the toe of the right shoe touched living Russian-thistle plants with the number of times the plants were absent. The

average percentage of plant stand at all sampling localities in an area was used to determine the equivalent acreage, or 100-percent Russian-thistle stand.

Roadside patches and sparse stands of thistle mixed with grass ordinarily do not support many beet leafhopper nymphs. All strips of thistle that extended less than 75 yards away from the road were therefore omitted, and records were not made of thistle stands of less than 10-percent cover.

Measurements of the density and condition of Russian-thistle and the beet leafhopper populations were determined by taking samples in representative Russian-thistle areas. The number of stops in an area to obtain data depended on its size and the amount of Russian-thistle present. Populations of beet leafhopper adults and nymphs were measured by means of the ½-square-foot sampling fork described by Lawson *et al.* (*4*). Ten samples were taken at each stop from Russian-thistle plants selected at random. These data gave the average population of leafhoppers per square foot. The total population was estimated by multiplying the average number of leafhoppers per square foot by the number of square feet computed for the equivalent acreage of Russian-thistle.

Abundance of Russian-Thistle

The distribution of Russian-thistle during 1934–39 is given in table 2 for four sections of southern Idaho. These figures are based on the total acreage regardless of the density of the stand. Russian-thistle was most abundant in 1936, when 920,306 acres were recorded, but its abundance decreased during the following years.

The data show that 66 percent of the annual acreage of this plant was in eastern Idaho in 1934, and then the acreage decreased there. The 46 percent of all Russian-thistle areas found in south-central Idaho in 1939 was an increase over the percentages for 1934–37. The study was continued there, since these areas were close to crops susceptible to curly top, a disease transmitted by the beet leafhopper. The relative abundance of Russian-thistle in western and central Idaho was low during 1934–39. However, the acreage in western Idaho was located close to crops that were susceptible to curly top and west of the entire irrigated district of southern Idaho. Since central Idaho was north of most of the irrigated district and the prevailing winds are from the west, the low acreage was not important in the production of beet leafhoppers that move to susceptible crops.

Four areas close to the cultivated lands in south-central Idaho were studied to determine the shift in Russian-thistle acreage. They were Golden Valley to the east of the cities of Jerome and Twin Falls, Hollister to the south, and King Hill and Mountain Home to the

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TABLE 2.—*Acreages of Russian-thistle in four sections of southern Idaho, 1934–39*

Year	Eastern		South-central		Western		Central		Total acres of all sections
	Total acres	Percentage of all areas	Total acres	Percentage of all areas	Total acres	Percentage of all areas	Total acres	Percentage of all areas	
1934	436, 643	65. 9	204, 180	30. 8	12, 909	1. 9	9, 224	1. 4	662, 956
1935	392, 719	61. 8	202, 406	31. 9	10, 946	1. 7	29, 541	4. 6	635, 612
1936	532, 159	57. 8	326, 445	35. 5	16, 467	1. 8	45, 235	4. 9	920, 306
1937	456, 565	63. 3	243, 547	33. 8	6, 832	. 9	14, 598	2. 0	721, 542
1938	211, 078	49. 0	194, 204	45. 0	5, 504	1. 3	20, 102	4. 7	430, 888
1939	191, 856	44. 6	199, 990	46. 5	4, 141	1. 0	33, 978	7. 9	429, 965

west. The results of this study are shown in table 3, in which the density of the Russian-thistle was considered and the figures were expressed as the equivalent of 100-percent stand.

TABLE 3.—*Acreages of Russian-thistle, expressed as the equivalent of 100-percent stand, in four areas of southern Idaho, 1934–54*

Year	Golden Valley	Hollister	King Hill [1]	Mountain Home	Total
1934	4, 887	4, 164	584	1, 509	11, 144
1935	6, 671	4, 886	3, 185	1, 152	15, 894
1936	12, 106	12, 263	12, 045	6, 690	43, 104
1937	9, 387	10, 165	8, 472	574	28, 598
1938	18, 697	2, 560	3, 605	2, 675	27, 537
1939	5, 052	7, 619	6, 897	2, 083	21, 651
1940	7, 948	1, 495	14, 508	1, 628	25, 579
1941	3, 163	363	7, 051	3, 270	13, 847
1942	1, 432	189	481	554	2, 656
1943	7, 408	2, 116	5, 305	2, 949	17, 778
1944	4, 919	463	10, 754	1, 964	18, 100
1945	1, 893	164	309	113	2, 479
1946	1, 633	1, 029	2, 853	839	6, 354
1947	4, 380	725	2, 097	235	7, 437
1948	3, 631	1, 987	2, 514	764	8, 896
1949	4, 061	908	46, 758	4, 130	55, 857
1950	4, 983	1, 370	14, 938	3, 874	25, 165
1951	13, 112	1, 681	10, 289	37, 416	62, 498
1952	5, 427	3, 684	29, 439	5, 091	43, 641
1953	3, 968	310	2, 262	395	6, 935
1954	5, 007	5, 416	9, 201	3, 384	23, 008

[1] Extensive Russian-thistle acreage in the Wendell area was included from 1949 to 1954.

The totals show that Russian-thistle was more abundant during 1936–40 and 1949–52. A comparison of the lowest and highest acreages shows a wide range from year to year, since in the Mountain Home area the lowest acreage (1945) was 0.3 percent of the highest (1951) and in the Golden Valley area the lowest acreage (1942) was 8 percent of the highest (1938). At the beginning of the study Russian-thistle was most abundant south and east of the cities of Jerome and Twin Falls, since the peaks of 12,263 acres were recorded in the Hollister area in 1936 and 18,697 acres in the Golden Valley area in 1938. By the end of the study extensive fires on the large gunnery ranges during World War II had destroyed the native vegetation, and Russian-thistle was most abundant west of Jerome and Twin Falls, since the peaks of 46,758 acres were recorded in the King Hill area in 1949 and 37,416 acres in the Mountain Home area in 1951.

Three other areas—Idahome, Minidoka, and Nyssa—were important during 1934–54. The Idahome area reached a peak of 30,100 acres of Russian-thistle in 1938 and decreased to 8,700 acres in 1944, when the study was ended in the Raft River Valley. During the

21-year period the amount of Russian-thistle in the Minidoka area, based on the equivalent of 100-percent stand, ranged from 0 to 18,000 acres. Records in the Nyssa area from 1941 to 1954 show a low of 2,500 and a high of 21,400. There were 4 years of high abundance, ranging from 11,000 to 21,400 acres, which coincided with the 1949–52 period of high acreage of Russian-thistle in southern Idaho. The combined summer breeding areas of the beet leafhopper in 1951 approximated 84,600 acres of 100-percent Russian-thistle extending in a broken line across southern Idaho from Burley, Idaho, to Vale, Oreg.

Fluctuation in Abundance of Russian-Thistle

Some of the factors responsible for the fluctuation in abundance of Russian-thistle were the availability of seed, amount of soil disturbance, amount of vegetation consumed by animals, plant competition for soil moisture, and amount of rainfall at critical periods. Piemeisel (*5*) discussed the successive plant cover and showed that the distribution of seed, time of germination, ability to survive winter conditions, and root system of these plants were important factors in the competition for the limited amount of soil moisture ordinarily available in southern Idaho.

The seed of winter annuals is generally destroyed after one or more years of cultivation and is not present where good stands of native vegetation have been present for several years. All the host plants of the beet leafhopper and downy chess produced an abundant supply of viable seed. Russian-thistle is the most abundant and widely distributed summer annual on the Snake River Plain of southern Idaho. After maturity in the fall, it breaks off at the surface of the ground and rolls before the wind, distributing its seed. Since the seeds are very light and winged, they continue to move with the wind after detachment from the mature plant.

The disturbance of soil by cultivation, overgrazing, and burning of native vegetation and the abandonment of land definitely increased the Russian-thistle acreage. This increase was very pronounced in 1936, 1949, and 1951, as shown in table 3.

Although Russian-thistle has an advantage in seed distribution, the fall-germinating and winter-surviving annuals are the first to use the soil moisture. The more important species of mustards, consisting of flixweed (*Descurainia sophia* (Lam.) Webb), perfoliate pepperweed (*Lepidium perfoliatum* L.), and tumblemustard (*Sisymbrium altissimum* L.), appear during the second or third year after the disturbance of the soil and vary from a few plants to good stands, which may cover several thousand acres. Although flixweed had been important, tumblemustard generally became more widely distributed during 1934–54. Perfoliate pepperweed became very important after the native vegetation was destroyed near Moun-

tain Home, Idaho. It covered approximately 10,500 acres in 1953. These winter annuals are important spring hosts of the beet leafhopper and produce the spring migrants that move to Russian-thistle, their summer host.

The abundance of downy chess during 1934–54 has been studied in connection with the fluctuation in the abundance of Russian-thistle. When this study was started in 1934, there were approximately 105,450 acres of downy chess. The acreage of this annual grass increased to 196,460 in 1942, 223,488 in 1945, and 486,646 in 1951. The yearly acreage is given in table 1 for 1945–54.

TC–893

FIGURE 5.—Downy chess invading a thin stand of sagebrush in the King Hill area in Idaho, June 3, 1951.

The acreage of downy chess and Russian-thistle during 2 typical years at the peak of Russian-thistle reduction is given in table 4. The Russian-thistle stand was sparse in 1945, when there were less than 2,500 acres in the four important beet leafhopper breeding areas compared in table 3. The increases in acreages of downy chess were larger than the decreases in Russian-thistle. It is not possible to show the amount of change resulting from all independent factors, but figure 5 shows a large area of overgrazed rangeland, where the sagebrush cover has become sparse and the area has been invaded by downy chess. These conditions are favorable for range fires, which destroy the plant cover and leave the land bare.

Range fires on the Snake River Plain in southern Idaho and eastern Oregon destroy nonhost plants of the beet leafhopper on thousands of

TABLE 4.—*Comparison of acreages of downy chess and Russian-thistle in southern Idaho and eastern Oregon, 1944 and 1945*

Plant cover [1]	1944	1945	Change
Pure downy chess	104, 077	215, 987	+111, 910
Downy chess and Russian-thistle	34, 932	7, 501	−27, 431
All downy chess	139, 009	223, 488	+84, 479
Pure Russian-thistle	48, 179	10, 694	−37, 485
All Russian-thistle	83, 111	18, 195	−64, 916

[1] Pure downy chess or pure Russian-thistle refers to those stands that do not have plants of other species. All downy chess or all Russian-thistle includes both the pure and mixed stands.

acres of grazing lands each season. The Bureau of Land Management of the United States Department of the Interior reported over 1,200,000 acres of rangelands burned in southern Idaho in 1941, practically all of which were on the Snake River Plain. Observations of the authors indicate that range fires generally originate where downy chess, an introduced annual grass, forms the plant cover or has entered deteriorated sagebrush areas. When downy chess matures and dries early in the summer, it becomes highly inflammable. During the fire season it is the greatest range fire hazard in the intermountain region, as it will burn like tinder. If this annual grass is burned under favorable conditions, it may reseed itself and again form the cover, but under unfavorable conditions, such as wind erosion and trampling by livestock, the mustards, principally tumblemustard, and Russian-thistle may appear.

The effects of the amount of precipitation on these annual plants have been studied throughout 1934–54. Table 5 shows that the dates when downy chess dried ranged from May 8 to July 1. Downy chess dried early in 1939, which was the year of low precipitation during

TABLE 5.—*Approximate dates when downy chess dried in two areas of southern Idaho, 1934–44*

Year	King Hill	Hollister
1934	May 15	May 28
1935	June 1	July 1
1936	May 25	May 25
1937	June 9	June 25
1938	May 31	June 14
1939	May 8	May 15
1940	June 1	June 10
1941	do	Do.
1942	do	June 12
1943	May 31	June 15
1944	May 20	June 20

the spring. The weather data for the 30 days prior to and after the drying of downy chess were examined. There was little indication that these periods appreciably affected the abundance of this annual plant during the following year.

The important period in which precipitation can be correlated with Russian-thistle acreage is during October, November, and December. Low precipitation in the fall does not permit the germination and growth of downy chess. As a result, there is greater grazing pressure from livestock and increased destruction of the vegetation. These conditions result in a larger amount of bare soil that Russian-thistle can cover in the spring, and with decreased competition for available soil moisture, this host plant has an increased acreage. A low rainfall in the late spring followed by a high rainfall early in the summer is often associated with increased acreage of Russian-thistle.

A good example of the fluctuation in abundance of Russian-thistle in the same locality from year to year occurred in the King Hill area in 1948 and 1949, as shown in table 3. During the summer of 1948 a sparse stand of Russian-thistle intermixed with a good stand of downy chess was growing on the range near King Hill. Conditions were adverse for fall germination of downy chess in the King Hill area in 1948, since snow covered the ground continuously from about November 30, 1948, to February 25, 1949, in south-central Idaho. Warm weather followed the melting of the winter's snow during the last part of February 1949, and Russian-thistle germinated along with downy chess on the rangelands. Above-normal temperature and deficient precipitation from the first of March until the middle of May increased the competition between this early-maturing annual grass and the fall-maturing Russian-thistle. This early competition resulted in a thin stand of downy chess and a good stand of Russian-thistle over the area.

The high precipitation during the fall of 1940 was followed by a great reduction in Russian-thistle acreage in the King Hill and Hollister areas in 1941, and the low precipitation in the falls of 1935 and 1936 resulted in greatly increased Russian-thistle acreages in these areas in 1936 and 1937. Precipitation records must be available for each area to draw conclusions, since in 1940 the acreage of Russian-thistle was large in the King Hill area and small in the Hollister area as a result of moderately heavy local showers around Hollister in the fall of 1939.

The acreage of Russian-thistle was also large in the Mountain Home area in 1951 and King Hill area in 1952. In the falls of 1950 in the Mountain Home and 1951 in the King Hill areas sufficient moisture at the recording stations stimulated a stand of downy chess. However, these stands did not develop, apparently because the normal vegetation had been recently burned, so downy chess seed may not have been sufficiently abundant or the fall rains may have been local.

Douglass *et al.* (*2*) also have studied the effects of climate on the beet leafhopper and its host plants. During severe winters in southern Idaho the snow cover is usually adequate to protect beet leafhoppers and young host plants from subzero temperatures. The subsequent melting of the snow provides ample moisture for the spring germination of Russian-thistle and other host plants.

Populations of Beet Leafhoppers on Russian-Thistle

The populations of the beet leafhopper during 1934–54 generally varied between the areas and the years in accordance with the acreage of Russian-thistle. Figure 6 shows an ideal stand of Russian-thistle, which was very common during the years when populations were high.

TC–1354

FIGURE 6.—Good stand of Russian-thistle on recently cleared ground, Murtaugh, Idaho, September 14, 1954.

The populations of the leafhopper are compared in table 6 and the Russian-thistle acreages in table 2 for southern Idaho during 1934–39. The peak population of 853 billion leafhoppers was recorded in 1935, but the peak of Russian-thistle was 920,306 acres in 1936. The important breeding area in 1934 was eastern Idaho, which produced 63 percent of the beet leafhoppers, but in 1938 south-central Idaho produced 74 percent of the leafhoppers. The eastern Idaho area had less Russian-thistle each year until the studies were partially discontinued in 1940 and entirely discontinued east of Burley, Idaho, after 1944.

TABLE 6.—*Populations of beet leafhoppers on Russian-thistle in four sections of southern Idaho, 1934–39*

Year	Eastern		South-central		Western		Central		Total of all areas (billion)
	Total (billion)	Percentage of all areas	Total (billion)	Percentage of all areas	Total (billion)	Percentage of all areas	Total (billion)	Percentage of all areas	
1934	370	63	208	36	6	1	0. 1	----------	584
1935	517	61	323	38	10	1	3	----------	853
1936	227	42	276	51	13	3	24	4	540
1937	100	39	149	59	1	----------	5	2	255
1938	25	21	90	74	4	3	2	2	121
1939	27	38	43	60	. 5	1	1	1	71

The abundance of this insect during 1934–39 ranged from 8 leafhoppers per square foot of Russian-thistle in 1939 to 67 in 1935, when the counts were made each fall. There were only 24 leafhoppers per square foot in 1936, when Russian-thistle acreage was at its peak.

To illustrate the importance of Russian-thistle in the current beet leafhopper problem, Russian-thistle during September 1949 covered an average of 54 percent of each acre examined in the King Hill area and the plants were infested, on an average, by 57 beet leafhoppers per square foot of land surface occupied. On this basis there were approximately 1,340,779 beet leafhoppers per acre, or an estimated total of over 62 billion of these insects infesting the 46,758 acres comprising the King Hill area. The highest population ever recorded on one small thistle plant growing in gravelly soil was 1,604, the average population for 10 samples in that location being 386 per square foot of thistle.

The breeding areas of the leafhopper became more important west of Burley, Idaho, after 1944, so the two sections of King Hill, Mountain Home, and Wendell areas and Golden Valley, Hollister, and Minidoka areas were studied separately during 1934–54. The first section is located west and the second south and east of Twin Falls, Idaho. The abundance of the leafhoppers, which has been plotted on a logarithmic scale in figure 7, shows irregularities in the high beet leafhopper populations on Russian-thistle, but there were definite peaks in 1935, 1940, 1949, and 1951. A sufficient population in some of the other years produced a large spring generation the following year, when spring conditions were favorable for leafhopper development. The population was low from 1941 to 1948, and since 1940 the important breeding areas have shifted definitely westward to the King Hill, Mountain Home, and Wendell areas.

The Russian-thistle acreage has also increased in the Nyssa area since 1945. When the leafhopper populations from this area were added to those in the other six areas (fig. 7), there were computed populations of 146 and 69 billion beet leafhoppers produced on Russian-thistle in 1949 and 1951, respectively, in the summer breeding areas between Burley, Idaho, and Vale, Oreg. These leafhoppers were strategically located to move east with the prevailing wind to important spring breeding areas, where their progeny would threaten crops susceptible to curly top during the following year.

Russian-Thistle Control

In some years when moisture conditions are favorable for downy chess, it has replaced Russian-thistle and thus has controlled the beet leafhopper, but plant stands of this annual grass are not stable and Russian-thistle often becomes abundant after a few years.

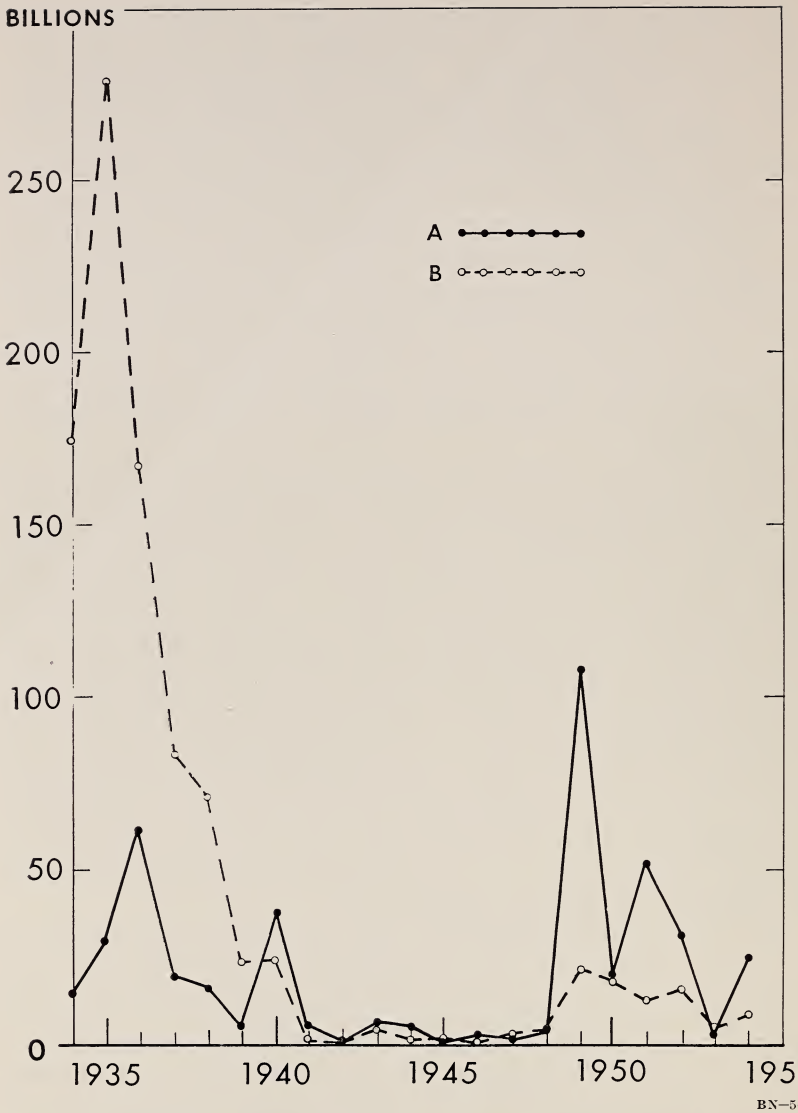

FIGURE 7.—Beet leafhopper populations on Russian-thistle during 1934–54 in south-central Idaho: *A*, King Hill, Mountain Home, and Wendell areas; *B*, Golden Valley, Hollister, and Minidoka areas.

Perennial grasses have been seeded in large areas of the intermountain region, and they have replaced Russian-thistle and other weed hosts of the beet leafhopper, thus constituting a permanent method of beet leafhopper control. Crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), a perennial, has been widely used in southern

Idaho to replace undesirable plants (fig. 8). Plummer *et al.* (*6*) discussed the value of perennial grasses for replacing weeds and showed that the carrying capacity of the range was often increased more than 10 times. They also described methods for eradicating downy chess and other undesirable weeds.

A recent article (*1*) showed that 350,000 acres of depleted rangeland have been reseeded in southern Idaho. Near Twin Falls, Idaho, the cost of reseeding has ranged from $2.38 to $6.86 per acre, with an average of $4.80. In one place near Raft River the carrying capacity of the range has been increased by reseeding and proper range management from "200 acres per cow month" to "3 acres per cow month,"

TC–967

FIGURE 8.—Pure stand of crested wheatgrass near Rupert, Idaho, June 5, 1952.

and on other ranges, mostly private, the carrying capacities have been increased 10 times or better. With proper range management the overgrazed and depleted ranges in southern Idaho can be restored, and thus the weed hosts of the beet leafhopper can be controlled and the carrying capacity of the range increased.

Summary

The distribution of Russian-thistle (*Salsola kali* var. *tenuifolia* Tausch) in southern Idaho and eastern Oregon and its importance in the production of the beet leafhopper (*Circulifer tenellus* (Baker)) were studied during 1934–54. Although this territory included over 13 million acres, Russian-thistle covered less than 1 million acres. The important Russian-thistle areas in 1934 were in eastern Idaho,

but a slightly larger acreage was in south-central Idaho than in eastern Idaho by 1939. More Russian-thistle was in the King Hill and Mountain Home areas during 1949–52 than in the Hollister and Golden Valley areas during any similar period.

Some of the factors responsible for the fluctuation in abundance of Russian-thistle include the availability of seed, amount of soil disturbance, amount of vegetation consumed by animals, plant competition for soil moisture, and amount of rainfall at critical periods. Russian-thistle appeared first on abandoned land, followed by several species of annual mustards, and then downy chess (*Bromus tectorum* L.), a nonhost of the beet leafhopper.

The populations of beet leafhoppers have varied in accordance with the acreage of Russian-thistle. In Idaho the eastern section produced 63 percent of the leafhoppers in 1934, but the south-central section produced 74 percent in 1938. The peak populations of this leafhopper during 1949–52 were recorded farther west in the King Hill, Mountain Home, and Wendell areas.

Downy chess has sometimes replaced Russian-thistle, thus controlling the beet leafhopper, but plant stands of this annual grass are not stable and Russian-thistle often becomes abundant after a few years. Perennial grasses, such as crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), have been seeded and have controlled this insect by permanently replacing its weed hosts in a few areas of southern Idaho.

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